



TEST REPORT

Determination of Dioxin and Arsenic Content in Air Emissions from the Combustion of Construction Demolition Debris and Treated Wood Fuels

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TABLE OF CONTENTS

1.0 INTRODUCTION.....	1
2.0 RESULTS & DISCUSSION	2
2.1 Sampling Parameters	2
2.2 Field Operations Schedule	2
2.3 Sampling Program	3
2.3.1 Dioxin/Furans Sampling and Analysis	2
2.3.1.1 Control Blend PCDD/PCDF Emission Measurements.....	3
2.3.1.2 Low Level PCDD/PCDF Emission Measurements	3
2.3.1.3 Moderate Level PCDD/PCDF Emission Measurements	4
2.3.2 Arsenic Sampling and Analysis	5
2.3.2.1 Control Level Arsenic Emission Measurements.....	5
2.3.2.2 Low Level Arsenic Emission Measurements.....	6
2.3.2.3 Moderate Level Arsenic Emission Measurements.....	7
2.3.3 Gaseous Emission Testing	8
2.3.3.1 Control Blend NO _x & CO Emission Measurements	8
2.3.3.2 Low Level NO _x & CO Emission Measurements.....	9
2.3.3.3 Moderate Level NO _x & CO Emission Measurements.....	10
2.3.4 Process and Ash Sampling	10
3.0 PROCESS & OPERATIONS	12
3.1 Boralex Stratton Energy, Inc.....	12
3.2 Operating Conditions During Testing.....	13
4.0 SAMPLING AND ANALYTICAL METHODOLOGY	14
4.1 Gaseous Reference Method Sampling	14
4.1.1 Calibrations	14
4.1.2 Data Acquisition	16
4.2 Manual Emission Measurement.....	16
4.2.1 Dioxin/Furans Emission Measurement.....	16
4.2.2 Arsenic Measurement	18
4.3 Fuel and Ash Sampling.....	20
4.3.1 As Combusted Fuel Sampling Procedures.....	20
4.3.2 Flyash Sampling Procedures	21
4.3.3 Bottom Ash Sampling Procedures	21
5.0 QUALITY ASSURANCE	22
5.1 Sampling Quality Assurance.....	22
5.2 Reference Method System	22

List of Tables and Figures

Table	2-1	Sampling Parameters	2
Table	2-2	PCDD/PCDF Emission Measurement Summary Control Blend.....	3
Table	2-3	PCDD/PCDF Emission Measurement Summary Low Level	4
Table	2-4	PCDD/PCDF Emission Measurement Summary Moderate Level	5
Table	2-5	Arsenic Emission Measurement Summary Control Blend	6
Table	2-6	Arsenic Emission Measurement Summary Low Level.....	7
Table	2-7	Arsenic Emission Measurement Summary Moderate Level.....	8
Table	2-8	NO _x & CO Emission Measurement Summary Control Level.....	9
Table	2-9	NO _x & CO Emission Measurement Summary Low Level.....	9
Table	2-10	NO _x & CO Emission Measurement Summary Moderate Level.....	10
Figure	4-1	Gaseous Sampling System Schematic	15
Figure	4-2	Dioxin/Furans Sampling Schematic	17
Figure	4-3	Arsenic Sampling Schematic	19

Appendix

Field Data Summary Sheets	Appendix A
Raw Field Data Sheets	Appendix B
Process Data Sheets	Appendix C
Calibration Data Sheets	Appendix D
Laboratory Analytical Data	Appendix E

1.0 INTRODUCTION

Air Tox Environmental Company, Inc. (Air Tox) of Willington, Connecticut was retained by Boralex to perform the specific tasks of Phase II outlined in the Boralex SEP Proposal to the Maine Department of Environmental Protection (ME-DEP). The purpose of this test program was to quantify dioxin and arsenic content in the air emissions resulting from controlled burns of clean wood (control), clean wood mixed with construction/demolition debris (CDD) woodchips containing small amounts of treated wood and clean wood mixed with CDD wood chips (CDW) and containing moderate amounts of treated wood. Testing occurred at the Boralex facility located in Livermore Falls, Maine. In addition to dioxin and arsenic testing, emissions testing for oxygen (O₂), carbon dioxide (CO₂), Oxides of Nitrogen (NO_x), and Carbon Monoxide (CO) was also conducted.

The testing program described herein was performed during the weeks of May 26th, 2004 and June 15th, 2004. The testing program was performed under the supervision of Ezra McCarthy, Environmental Engineer of Air Tox, with Todd Wheeler and Eric Dithrich, Senior Environmental Engineers, and Shayne Bernier, Ben Katterson, Lauren Sansoucy, and Jessie Amsel Environmental Technicians providing field support. Ezra supervised all field operations during the performance of this test program. Caleb Bryant, Operations Manager for the Boralex Livermore Falls facility and William Parker, Environmental Manager for Boralex, oversaw all production operations during this test program.

Section 2.0 of this of this report presents the results and discussion of the sampling program. A description of the process and operations is presented in Section 3.0. Sampling and analytical methodologies, including sampling train are presented in Section 4.0. Air Tox's Quality Assurance Plan is detailed in Section 5.0.

2.0 RESULTS AND DISCUSSION

This section details the results of the emissions testing program that was performed on the wood fired boiler operating at Boralex's facility located in Livermore Falls, Maine. Specifically, this section of the report includes the sampling parameters, a brief description of the test methodologies, and the results presented.

2.1 Sampling Parameters

The compliance program consisted of the following parameters and test methodologies, which were sampled from the outlet to the ESP abatement systems (stack) serving the wood fired boiler.

**Table 2-1
Measured Emission Parameters**

<u>EMISSION PARAMETER</u>	<u>REFERENCE METHOD</u>
<ul style="list-style-type: none">• Flowrate (ACM & DSCFM))• Molecular Weight (O₂ & CO₂)• Moisture (H₂O)• Oxides of Nitrogen (NO_x)• Carbon Monoxide (CO)• Dioxins/Furans (PCDD/PCDF)• Arsenic (As)	<ul style="list-style-type: none">• EPA Methods 1 & 2• EPA Method 3A• EPA Method 4• EPA Method 7E• EPA Method 10• EPA Method 23• EPA Method 29

2.2 Field Test Changes and Deviations

During this test program Air Tox experienced one deviation. Due to lack of information from the laboratory that was analyzing the wood fuel Boralex Inc was unable to mix the fuel at the proper levels. This delayed the testing program for two weeks. When testing resumed there were no further complications.

2.3 Sampling Program

2.3.1 Dioxins/Furans Sampling & Analysis

Three (3) three-hour PCDD/PCDF's test runs (nominal) were performed at the exhaust stack of the wood fired boiler on each of the three (3) fuel blend levels equaling nine (9) test runs. Sampling for PCDD/PCDF was performed in strict accordance with 40 CFR Part 60, Appendix A, EPA Reference Method 23. Current with the Method 23 sampling, flowrate, O₂, CO₂, and percent moisture were determined, in accordance with 40 CFR Part 60, Appendix A, EPA Reference Method 1, 2, 3A, and 4, respectively, as required by the method.

The PCDD/PCDF samples were shipped to Alta Analytical Perspectives of Wilmington, North Carolina for PCDD/PCDF (total tetra- through octa- congeners) analysis. Yves Tondue, Ph.D., General Manager, Alta Analytical Perspectives was the laboratory contact responsible for

the PCDD/PCDF sample analysis. Results from the sample analysis are reported in the units of nanograms TEQ per dry standard cubic meters corrected to 7.0 % oxygen (ng TEQ/dscm @ 7% O₂).

2.3.1.1 Control Blend PCDD/PCDF Emission Measurements

Three (3) three-hour PCDD/PCDF test runs were performed on May 26th, 2004 on the outlet stack of the boiler while firing a control blend of pre-tested clean wood only (whole tree chips and mill residues). The boiler was operated at normal load conditions during the performance of this test program. A summary of the PCDD/PCDF emission measurements for the three control level test runs is provided below in Table 2-2.

The total PCDD/PCDF average emission measurement of 0.0106 ng/dscm corrected to 7.0% O₂ are expressed as TCDD based on U.S. EPA toxic equivalents factors (TEF's). All field and laboratory data is presented in the Appendix of this report.

Table 2-2
PCDD/PCDF Emission Measurement Summary
Control Blend (< 4.0 ppt - TEQ)
Boralex – Livermore Falls

Test No.		D/F-T1 Control	D/F-T2 Control	D/F-T3 Control	
Date		5/26/2004	5/26/2004	5/26/2004	
Time		07:30 - 10:40	10:45 - 13:52	13:55-16:57	
	Units				Average
Stack Temperature	deg. F	326.8	326.6	325.1	326.2
Volume of Sample	dscm	5.18	2.84	2.94	3.73
Carbon Dioxide Content	%	12.3	12.3	12.3	12.3
Oxygen Content	%	8.7	8.7	8.6	8.7
Isokinetic Ratio	%	104.7	105.1	106.0	105.3
Moisture Content	%	20.6	20.1	19.9	20.21
Total PCDD/F's	ng/dscm @7% O₂	1.35	1.17	1.06	1.19
Total PCDD/F's (TEQ)	ng/dscm @7% O₂	0.0152	0.00914	0.00745	0.0106

2.3.1.2 Low Level PCDD/PCDF Emission Measurements

Three (3) three-hour PCDD/PCDF test runs were performed June 16th, 2004 on the outlet stack of the boiler while firing a control blend of 10% CDW, 90% clean wood and 0.04% pentachlorophenol (PCP) treated wood. The boiler was operated at normal load conditions during the performance of this test program. A summary of the PCDD/PCDF emission measurements for the three low-level test runs is provided below in Table 2-3.

The total PCDD/PCDF average emission measurement of 0.104 ng/dscm corrected to 7.0% O₂ are expressed as TCDD based on U.S. EPA toxic equivalents factors (TEF's). All field and laboratory data is presented in the Appendix of this report.

Table 2-3

PCDD/PCDF Emission Measurement Summary
Low Level (< 16 ppt - TEQ)
Boralex – Livermore Falls

Test No.		D/F-T1 Low Level	D/F-T2 Low Level	D/F-T3 Low Level	
Date		6/16/2004	6/16/2004	6/16/2004	
Time		08:00 - 11:08	11:10 - 14:16	14:17-17:23	
	Units				Average
Stack Temperature	deg. F	323.7	321.3	321.8	322.3
Volume of Sample	dscm	2.94	2.81	2.89	2.88
Carbon Dioxide Content	%	13.3	13.1	12.7	13.0
Oxygen Content	%	7.7	7.8	8.2	7.9
Isokinetic Ratio	%	105.6	101.7	102.3	101.77
Moisture Content	%	20.8	18.4	17.7	18.95
Total PCDD/F's	ng/dscm @7% O₂	7.78	6.38	5.32	6.49
Total PCDD/F's (TEQ)	ng/dscm @7% O₂	0.121	0.106	0.0840	0.104

2.3.1.3 Moderate Level PCDD/PCDF Emission Measurements

Three (3) three-hour PCDD/PCDF test runs were performed June 17th, 2004 on the outlet stack of the boiler while firing a control blend of 50% CDW and 0.25% PCP- treated wood and 50% clean wood. The boiler was operated at normal load conditions during the performance of this test program. A summary of the PCDD/PCDF emission measurements for the three moderate level test runs is provided below in Table 2-4.

The total PCDD/PCDF average emission measurement of 0.0417 ng/dscm corrected to 7.0% O₂ are expressed as TCDD based on U.S. EPA toxic equivalents factors (TEF's). All field and laboratory data is presented in the Appendix of this report.

Table 2-4

PCDD/PCDF Emission Measurement Summary
Moderate Level (< 95 ppt - TEQ)
Boralex – Livermore Falls

Test No.		D/F-T1 Moderate Level	D/F-T2 Moderate Level	D/F-T3 Moderate Level	
Date		6/17/2004	6/17/2004	6/17/2004	
Time		06:30 - 09:34	09:35 - 12:39	12:40-15:43	
	Units				Average
Stack Temperature	deg. F	315.5	318.7	324.0	319.4
Volume of Sample	dscm	2.75	2.86	2.92	2.84
Carbon Dioxide Content	%	11.9	13.6	13.3	12.9
Oxygen Content	%	8.2	7.5	7.7	7.8
Isokinetic Ratio	%	99.5	101.6	104.5	101.9
Moisture Content	%	17.8	17.6	17.6	17.66
Total PCDD/F's	ng/dscm @7% O₂	3.85	1.89	2.20	2.65
Total PCDD/F's (TEQ)	ng/dscm @7% O₂	0.0539	0.0323	0.0389	0.0417

2.3.2 Arsenic/Particulate Sampling & Analysis

Three (3) two-hour arsenic test runs (nominal) were performed at the exhaust stack of the boiler on each of the three (3) fuel blend levels equaling nine (9) test runs. Sampling for the Arsenic was performed in strict accordance with 40 CFR Part 60, Appendix A, EPA Reference Method 29. Current with the Method 29 sampling, flowrate, O₂, CO₂, and percent moisture were determined, in accordance with 40 CFR Part 60, Appendix A, EPA Reference Method 1, 2, 3A, and 4, respectively, as required by the methods.

The arsenic samples were shipped to Northeast Generation Services Laboratories of West Springfield, Massachusetts for arsenic analysis. Madhu Shah, Analytical Laboratory Manager, Northeast Generation Services Laboratories was the laboratory contact responsible for the arsenic (As) sample analysis.

Results from the particulate sample analysis are reported in the units of milligrams per dry standard cubic meters corrected to 7.0 % oxygen (mg/dscm @ 7% O₂).

2.3.2.1 Control Level Arsenic Emission Measurements

Three (3) two hour test runs were performed on May 26th, 2004 at the outlet stack of the boiler firing a control blend of pre-tested clean wood only. The boiler was operated at normal load conditions during the performance of this test program. A summary of the arsenic emission measurements for the three test runs is provided in Table 2-5.

The average arsenic emission measurement at the outlet location is 0.031 mg/dscm corrected to 7.0% O₂. All field and laboratory data is presented in the Appendix of this report.

Table 2-5

**Arsenic Emission Measurement Summary
Control Blend (< 0.1 ppm Arsenic)
Boralex – Livermore Falls**

Test No.		MM-T1 Control Level	MM-T2 Control Level	MM-T3 Control Level	
Date		5/26/2004	5/26/2004	5/26/2004	
Time		07:35-09:44	10:50-12:58	13:56-15:02	
	Units				Average
Sample Volume	dscm	3.27	1.95	1.98	2.40
Percent CO ₂	%	12.3	12.3	12.3	12.3
Percent O ₂	%	8.6	8.6	8.6	8.6
Moisture	%	21.4	19.3	20.6	20.4
Isokinetic Ratio	%	107.63	101.04	103.30	103.99
Arsenic	mg/dscm @ 7.0% O₂	0.042	0.025	0.025	0.031

2.3.2.2 Low Level Arsenic Emission Measurements

Three (3) two hour test runs were performed on June 16th, 2004 at the outlet stack of the boiler while firing a control blend of 10% CDW and 90% clean wood and 0.04% PCP treated wood. The sample runs were divided over two days to coincide with the PCDD/PCDF sample run schedule. The boiler was operated at normal load conditions during the performance of this test program. A summary of the arsenic and particulate emission measurements for the three test runs is provided in Table 2-6.

The average arsenic emission measurement at the outlet location is 0.120 mg/dscm corrected to 7.0% O₂. All field and laboratory data is presented in the Appendix of this report.

Table 2-6

Arsenic & PM Emission Measurement Summary
Low Level (< 1.6 ppm Arsenic)
Boralex – Livermore Falls

Test No. Date Time		MM-T1 Low Level 6/16/2004 08:05-10:10	MM-T2 Low Level 6/16/2004 11:15-13:23	MM-T3 Low Level 6/16/2004 14:03-16:09	
	Units				Average
Sample Volume	dscm	1.94	1.93	1.90	1.92
Percent CO ₂	%	13.3	13.1	12.6	13.0
Percent O ₂	%	7.6	7.9	8.3	7.93
Moisture	%	20.56	18.71	18.07	19.11
Isokinetic Ratio	%	102.8	100.3	99.6	100.9
Arsenic	mg/dscm @ 7.0% O₂	0.121	0.123	0.117	0.120

2.3.2.3 Moderate Level Arsenic Emission Measurements

Three (3) two hour test runs were performed on June 17th, 2004 at the outlet stack of the boiler while firing a moderate level controlled blend of 50% CDW and treated wood and 50% clean wood and 0.25% PCP-treated wood. The sample runs were divided over two days to coincide with the PCDD/PCDF sample run schedule.

The boiler was operated at normal load conditions during the performance of this portion of the test program. A summary of the arsenic emission measurements for the three test runs is provided in Table 2-7.

The average arsenic emission measurement at the outlet location was 0.062 mg/dscm corrected to 7.0% O₂. All field and laboratory data is presented in the Appendix of this report.

Table 2-7

Arsenic & PM Emission Measurement Summary
Moderate Level (14 ppm Arsenic)
Boralex – Livermore Falls

Test No. Date Time		MM-T1 Moderate Level 6/17/2004 06:30-08:37	MM-T2 Moderate Level 6/17/2004 09:26-11:34	MM-T3 Moderate Level 6/17/2004 12:30-14:35	
	Units				Average
Sample Volume	dscm	1.90	1.91	1.87	1.89
Percent CO ₂	%	11.1	13.6	13.3	12.67
Percent O ₂	%	8.7	7.60	7.7	8.00
Moisture	%	17.0	17.3	17.8	17.4
Isokinetic Ratio	%	99.6	100.3	103.9	101.3
Arsenic	mg/dscm @ 7.0% O₂	0.072	0.056	0.058	0.062

2.3.3 Gaseous Emissions Testing

In addition to the emissions parameters listed above NO_x and CO were sampled in accordance with 40 CFR Part 60, Appendix A, EPA Reference Methods 7E and 10, respectively. Sampling was conducted during the entire testing period coinciding with each test run. The data was recorded for later reporting.

Three (3) tests were performed during each of the three (3) fuel blends on the outlet stack of the boiler determine NO_x and CO emissions. The sample runs were divided over three days to coincide with the manual method sample run durations. The boiler was operated at normal load conditions during the performance of this test program. Summaries of the NO_x and CO emission measurements for the three fuel blends are provided below in Tables 2-8 through 2-10.

2.3.3.1 Control Level NO_x and CO Emission Measurements

Three (3) tests were performed on May 26th, 2004 on the outlet stack of the boiler determine NO_x and CO emissions while firing a control blend of pre-tested clean wood only. NO_x emission concentrations were calculated for each test run in terms of ppm, lbs/MMBtu, and lbs/Hr and CO emission concentrations were calculated in terms of ppm and lbs/MMBtu. Emission concentrations for NO_x averaged 84.7ppm and 0.149lbs/MMBtu. Emission concentrations for CO averaged 225.8ppm and 0.246lbs/MMBtu. Emissions data summaries, copies of the recorded instrument data as recorded during testing, including calibrations, are presented in the Appendices of this report.

Table 2-8

**NO_x & CO Emission Measurement Summary
Control Level Tests
Boralex – Livermore Falls**

Test Number	Date Tested	Time of Test Run	CO (lbs/MMBtu)	NO _x (lbs/MMBtu)	NO _x (lbs/hr)
1	5/26/04	07:30-10:40	0.259	0.164	99.5
2	5/26/04	10:45-13:52	0.214	0.141	80.8
3	5/26/04	13:55-16:57	0.266	0.144	90.6
Average	-	-	0.246	0.149	90.3

2.3.3.2 Low-Level NO_x and CO Emission Measurements

Three (3) tests were performed on June 16th, 2004 on the outlet stack of the boiler determine NO_x and CO emissions while firing a control blend of 90% pre-tested clean wood, 10% CDW and 0.04% PCP treated wood. NO_x emission concentrations were calculated for each test run in terms of ppm, lbs/MMBtu, and lbs/Hr and CO emission concentrations were calculated in terms of ppm and lbs/MMBtu. Emission concentrations for NO_x averaged 97.3ppm and 0.160lbs/MMBtu. Emission concentrations for CO averaged 290.1ppm and 0.295lbs/MMBtu. Emissions data summaries, copies of the recorded instrument data as recorded during testing, including calibrations, are presented in the Appendices of this report.

Table 2-9

**NO_x & CO Emission Measurement Summary
Low-Level Tests
Boralex – Livermore Falls**

Test Number	Date Tested	Time of Test Run	CO (lb/MMBtu)	NO _x (lbs/MMBtu)	NO _x (lb/Hr)
1	6/16/04	08:00-11:08	0.337	0.162	106.0
2	6/16/04	11:10-14:16	0.241	0.158	101.7
3	6/16/04	14:17-17:23	0.306	0.160	101.2
Average	-	-	0.295	0.160	103.0

2.3.3.3 Moderate-Level NO_x and CO Emission Measurements

Three (3) tests were performed during June 17th, 2004 on the outlet stack of the boiler determine NO_x and CO emissions while firing a control blend of 50% pre-tested clean wood, 50% CDW and 0.25% PCP treated wood. NO_x emission concentrations were calculated for each test run in terms of ppm, lbs/MMBtu, and lbs/Hr and CO emission concentrations were calculated in terms of ppm. Emission concentrations for NO_x averaged 95.4ppm and 0.161lbs/MMBtu. Emission concentrations for CO averaged 389.47ppm and 0.397lbs/MMBtu. Emissions data summaries, copies of the recorded instrument data as recorded during testing, including calibrations, are presented in the Appendices of this report.

Table 2-10

**NO_x & CO Emission Measurement Summary
Moderate Level Tests
Boralex – Livermore Falls**

Test Number	Date Tested	Time of Test Run	CO (lb/MMBtu)	NO _x (lbs/MMBtu)	NO _x (lbs/Hr)
1	6/17/04	06:30-09:34	0.323	0.156	93.9
2	6/17/04	09:35-12:39	0.409	0.162	104.3
3	6/17/04	12:40-15:43	0.460	0.165	104.4
Average	-	-	0.397	0.161	100.9

2.3.4 Process and Ash Sampling

Fuel samples were taken by an Air Tox representative to determine PCDD/PCDF and arsenic levels before entering the combustion process. All fuel samples were taken from the in-feed conveyor, prior to the fuel entering the metering bin. Once the “as combusted” fuels were sampled they were delivered, by Boralex, to Maine Environmental Laboratory (MEL). Boralex was responsible for the transport and analysis of all “as combusted” fuel samples for the three (3) fuel blend levels. Procedures for this sampling are included in Section 4.2.3 of this test report.

Flyash samples were taken by an Air Tox representative to determine PCDD/PCDF and arsenic levels after combustion. All flyash samples were collected directly after the flyash conditioner in the ash silo. Once the flyash samples were collected they were delivered by Boralex, to MEL. Boralex was ultimately responsible for the transport and analysis of the flyash samples for the three (3) fuel blends. Procedures for this sampling can be found in Section 4.2.4 of this test report.

Bottom ash samples were collected by an Air Tox representative to determine PCDD/PCDF and arsenic levels after combustion. Bottom ash samples were collected directly

off the wet ash drag conveyor. Once the bottom ash samples were collected Boralex assumed responsibility to deliver the samples to MEL. Bottom ash sampling procedures can be found in Section 4.2.5 of this test report.

3.0 PROCESS AND OPERATIONS:

3.1 Boralex Livermore Falls, Inc.

The Boralex Livermore Falls Inc. facility is located on the Diamond Road in Livermore Falls, Maine. Included at the ±45-acre site is a 39.9 megawatt (gross) power plant fueled by clean wood fuels (whole tree chips and mill residues) and CDD. At the writing of this SEP proposal combustion of all treated wood has been curtailed.

The combustion unit, manufactured by Zern Industries Inc. consists of a spreader-stoker traveling grate system. No provisions to fire oil are installed. The unit produces 334,000 lbs. of steam per hour at 850 – 900 psig and 900° F. steam temperature. A General Electric steam turbine and generator set converts the produced steam to 36 megawatts (net) of electrical power. Ancillary equipment and the associated fuel management system complete the project.

Emissions are controlled by way of a DCS automatic combustion control system, over-fire air and undergrate air control, O₂ feedback, char re-injection, air heater, mutlicyclone and electrostatic precipitator (ESP). A urea injection system is installed to control oxides of nitrogen (NO_x) to 0.15 lbs. / mmBtu. Emissions are continuously monitored for NO_x, carbon monoxide (CO), oxygen (O₂) and opacity.

In July of 1999 the facility received MEDEP approval to process up to 100,000 tons per year of clean construction and demolition wood, Reprocessed Wood Fuel (RWF) - treated wood (including telephone polls, rail road ties and pressure treated lumber), stumps and brush annually. The produced chips would be combined with the existing clean wood fuel stream. In September of 1999 MEDEP issued a Part 70 Air Emission License (A-555-70-A-I) approving the use of Construction and Demolition Wood Debris (CDWD) and Reprocessed Wood Fuel (RWF - treated wood) at an annual feed rate of up to 30% CDD by weight and 10% RWF by weight. In April of 2001 a Minor Modification (A-368-70-B-M) to the facility's air emission license was issued, approving the combustion of up to 10,000 tons per year of knots and screenings from a local paper mill.

Again, in April of 2001 a Minor Change to the facility air emission license was issued which allowed the facility to increase the amount of CDD fuel from 30% by weight annual average to 60% by weight annual average.

3.2 Operating Conditions During Testing

RUN #	DESCRIPTION	BLEND	TARGET PCDD/F	TARGET ARSENIC
1	CONTROL	CLEAN WOOD ONLY	< 4.0 ppt – TEQ	< 0.1 ppm
2	LOW LEVEL	CDD & CLEAN WOOD	16 ppt – TEQ	1.6 ppm
3	MODERATE LEVEL	CDD, CLEAN WOOD AND TREATED WOOD	95 ppt – TEQ	14 ppm

4.0 SAMPLING AND ANALYTICAL METHODOLOGY

Emission measurements were performed during this compliance test program at the wood fired boiler's main exhaust stack to determine concentrations and/or emission rates of arsenic (As), dioxins/furans (PCDD/PCDF), carbon dioxide (CO₂), and oxygen (O₂), nitrogen oxides (NO_x), and carbon monoxide (CO). Presented below are the sampling and analytical methodologies that were used to measure the constituents listed above.

4.1 Gaseous Reference Method Sampling System

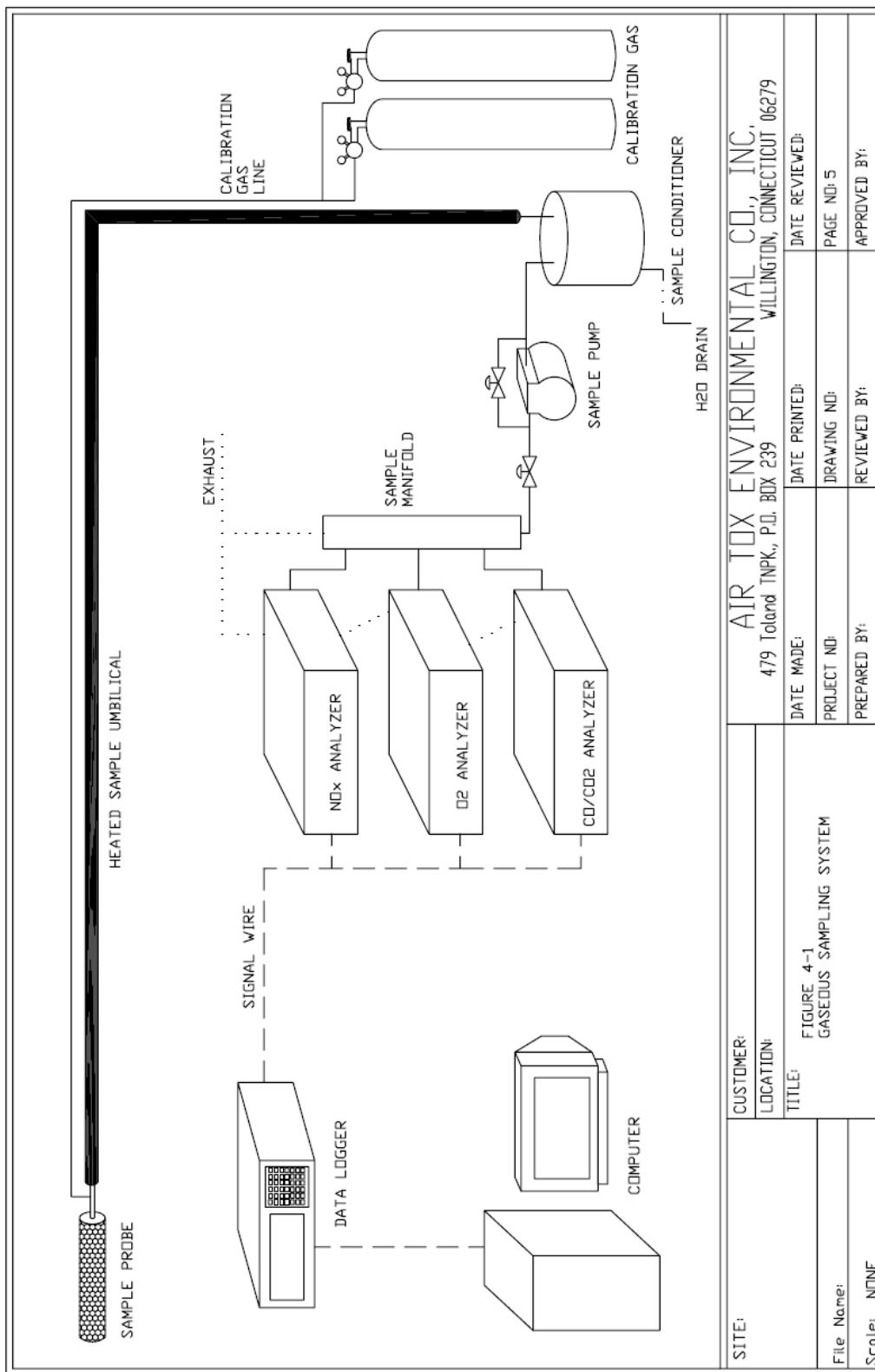
Instrumental monitoring was performed at the stack sampling location to determine concentrations of O₂/CO₂ and CO according to EPA Reference Methods 3A and 10, respectively. A schematic of the continuous sampling system is presented in Figure 4-1. The system is housed in Air Tox's mobile testing laboratory and was situated next to the electrostatic precipitator and the outlet stack. Stack gas was drawn through a sintered stainless steel probe, heated Teflon sample line (250°F nominal), a Peltier sample conditioner, and a final filter by a leakless Teflon diaphragm pump. The sample was then pumped through a manifold under slightly positive pressure with a bypass to atmosphere. Samples were continuously drawn from this manifold to each analyzer. Exhaust stack concentrations of carbon monoxide were determined using a California Analytical Instruments Model ZRH Dual Component CO/CO₂ analyzer, which utilizes non-dispersive infrared (NDIR) technology. The ranges utilized for this test program will be 0 - 1000 ppm CO and 0 - 25% CO₂. Exhaust stack oxygen concentrations were measured using a Servomex Model 1400 oxygen analyzer. The Model 1400 uses paramagnetic technology to measure sample stream oxygen concentration on a 0 to 25% (by volume) full scale. A Thermo Environmental Instruments Model 42C chemiluminescent NO_x analyzer was used to continuously monitor emissions of nitric oxide as NO_x. Air Tox utilized a 0 - 250 ppm range for this test program.

A single point was used for all continuous instrumental sampling. An in-stack sintered sample probe of 4-foot length was used to draw a reasonably integrated sample from the exhaust stack.

4.1.1 Calibrations

A three point (zero, mid, and span) calibration was performed directly on each analyzer (bypassing the sample transport and conditioning system) at the beginning of each test program to determine calibration error and demonstrate analyzer linearity.

A zero and upscale bias check and calibration drift check was also performed prior to and after each test run. An injection point at the sample extraction probe was used for the Figure 4-1 CEMS Schematic introduction of gases to the entire sample transport and conditioning system. EPA Protocol 1 gases, at concentrations within the ranges specified in each test method, were used for all calibrations. Calibration drift was determined using the pre-run and post-run monitor responses. Calibration drift, if any, was used to correct the average test run concentrations. Procedures and calculations contained in EPA Reference Method 6C were used to determine calibration error, bias, drift, and the average corrected stack concentration of the measured constituents.



SITE:	CUSTOMER:	AIR TOX ENVIRONMENTAL CO., INC.,			
	LOCATION:	479 Toland TPK., P.O. BOX 239 WILLINGTON, CONNECTICUT 06279			
File Name:	TITLE:	FIGURE 4-1		DATE MADE:	DATE REVIEWED:
	GASEOUS SAMPLING SYSTEM		PROJECT NO:	DRAWING NO:	PAGE NO: 5
Scale: NONE		PREPARED BY:	REVIEWED BY:	APPROVED BY:	

4.1.2 Data Acquisition

All continuous gaseous monitoring data were recorded using an ESC Model 8816 data logger supported by ESC's E-DAS software. Analyzer signals were viewed by the logger at 1-second intervals, forming one-minute averages. Averages for discrete one-hour test periods were then reported using ESC's report functions. All analyzer calibration responses are printed as calibration reports utilizing the data logger's capabilities to run timed sequences and reporting functions.

4.2 Manual Emission Measurements

Manual emission measurements were performed to determine the stack concentrations and emission rates of particulate matter, dioxins/furans and arsenic. Sampling was performed in accordance with EPA Reference Methods 23, and 29, respectively.

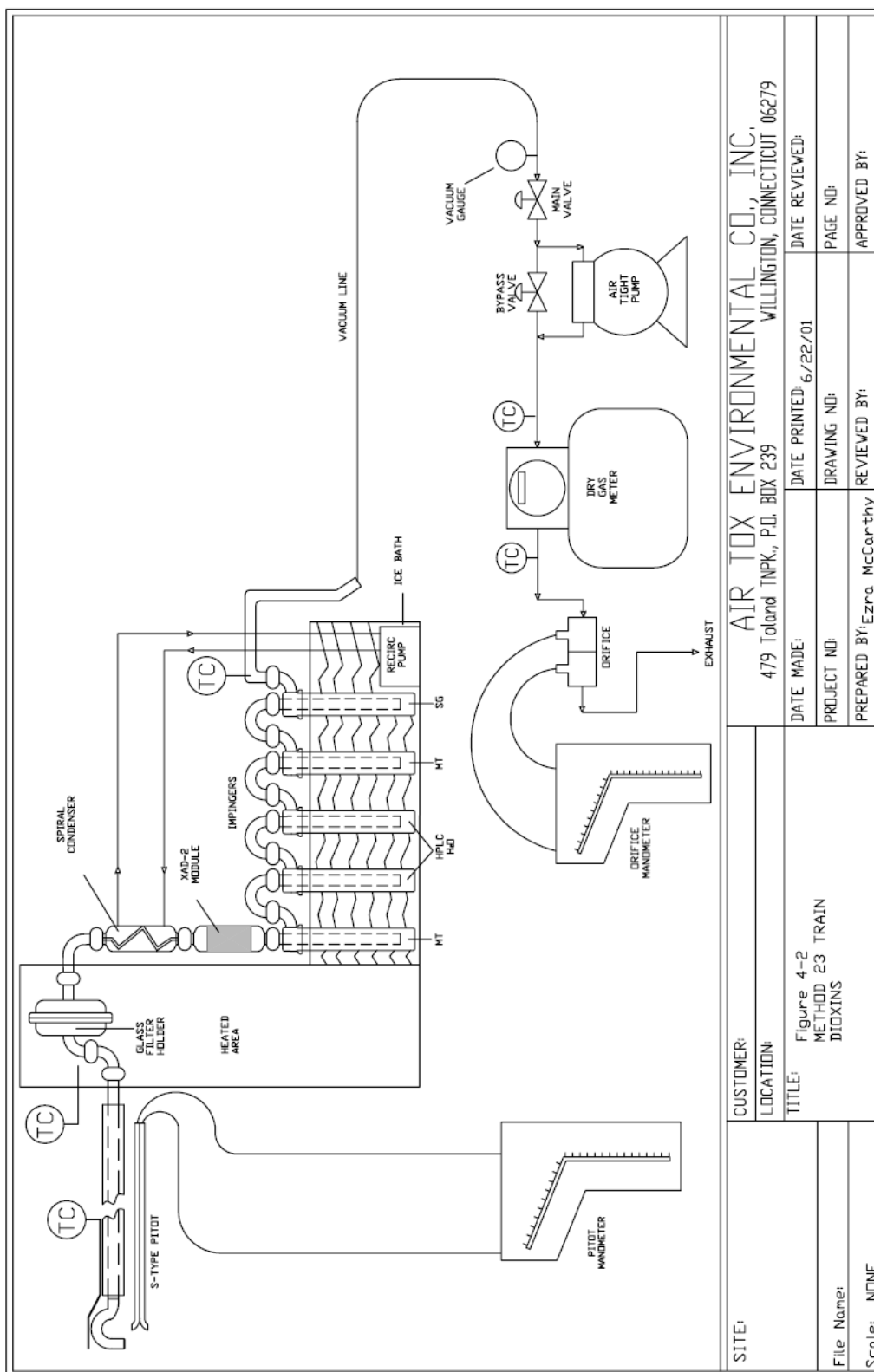
4.2.1 Dioxins/Furans Emission Measurement

Measurement of Polychlorinated Dibenzo-p-Dioxins (PCDD's) and Polychlorinated Dibenzofurans (PCDF's) were performed in accordance with EPA Reference Method 23. A total of three 3-hour isokinetic test runs were performed for each of the three fuel blends during this test program. This method is essentially a modified version of Reference Method 5. The train consists of a calibrated quartz nozzle, a heated quartz-lined probe, a heated glass fiber (pre-cleaned) filter encased in a glass holder with a Teflon frit, a flexible heated Teflon sample line, a Graham spiral-type condenser, a water jacketed sorbent module containing cleaned XAD-2 resin, and five Greenburg-Smith impingers. The sorbent module is positioned vertically and sample gas flows downward to prevent channeling. The first impinger is modified to serve as a moisture knockout by shortening the stem. Impinger's two and three are each charged with 100 ml HPLC water. The fourth impinger is empty, while the fifth contains 200 grams of indicating silica gel.

Prior to testing, all sample train components were cleaned and assembled in accordance with Section 4.1 of Reference Method 23. Glassware connections utilized Teflon/silicon O-rings to provide a leak-free seal without the use of silicone grease. Prior to and following sampling, the sample train was sealed with hexane rinsed aluminum foil to prevent contamination. Upon completion of each three-hour sample run, the train components were moved to a relatively clean area (Air Tox's Mobile Laboratory) to minimize the chances of contamination during sample recovery. A schematic of the sampling train is presented in Figure 4-2.

The sample train was then inspected for abnormal conditions and completely disassembled. Samples were recovered and placed in five sample containers, as follows:

<u>Container No. 1</u>	Filter
<u>XAD-2 Adsorbent Module</u>	Module was removed from sample train, immediately sealed with hexane rinsed aluminum foil, and stored on ice for transport to the laboratory.



Container No. 2

Acetone/methylene chloride washes of probe and front half of filter holder. The probe and nozzle were washed and brushed three times, followed by three rinses (no brushing) with methylene chloride. The back half of the filter holder, the transfer line (if used), and the spiral condenser were also rinsed three times with acetone and three times with methylene chloride. These rinses were deposited in this container. The container was sealed, labeled, and the liquid level marked.

Container No. 3

The transfer line, and condenser were washed three times with toluene and deposited in this container. The container was sealed, labeled, and the liquid level was marked.

The contents of the first four impingers were measured to the nearest 1.0 ml to determine moisture gain and discarded. The silica gel from the fifth impinger was weighed to the nearest 0.5 grams following each test run and saved for future use.

The samples were then transported to the laboratory where the following analyses were performed:

Container Nos. 1 -3, & XAD-2 Perform analysis by gas chromatography/mass spectrometry in accordance with Section 5 of Reference Method 23.

4.2.2 Arsenic Measurement

The exhaust stack concentration of arsenic was determined utilizing Reference Method 29. Three (3) two-hour isokinetic test runs were performed to determine the emissions of arsenic. This method is essentially a modified version of Reference Method 5. The train consists of a calibrated quartz nozzle, a heated quartz-lined probe, a heated glass fiber (pre-cleaned) filter encased in a glass holder with a Teflon-coated wire frit, and seven impingers. The first impinger is an empty, modified Greenburg-Smith type, used to serve as a moisture knockout. Impingers two (modified Greenburg-Smith) and three (Greenburg-Smith) are each charged with 100 ml of a nitric acid/hydrogen peroxide solution (5% HNO₃/10% H₂O₂). The fourth impinger is empty. The fifth impinger contains 200 grams of indicating silica gel to remove any remaining moisture.

Prior to testing, all sample train components were cleaned and assembled in accordance with Section 5.1.1 of Reference Method 29. Glassware connections utilized Teflon/silicon O-rings to provide a leak-free seal without the use of silicone grease. Prior to and following sampling, the sample train was sealed with Parafilm to prevent contamination. Upon completion of each two-hour sample run, the train components were moved to a relatively clean area (Air Tox's Mobile Laboratory) to minimize the chances of contamination during sample recovery. A schematic of the sampling train is presented in Figure 4-3.

The sample train was then inspected for abnormal conditions and completely disassembled. Samples were recovered and placed in five (optionally six) sample containers, as follows:

Container No. 1

Filter was removed from holder and deposited in 1000 ml sample jar. The nozzle, probe, and front half of the filter holder and brushed and rinsed in triplicate with 100 ml of nitric acid solution. The washes were deposited into this container. Container was labeled and sealed for transport.

Container No. 2

Contents of impingers 1, 2, & 3. Contents were measured to determine moisture gain and deposited into sample jar. The back half of the filter holder, the first three impingers, and connecting glassware were rinsed in triplicate with 100 ml nitric acid solution. Container was labeled and sealed for transport.

Container No. 3

Contents of impinger 4. Contents were measured to determine moisture gain and deposited into sample jar. The impinger was rinsed in triplicate with 100 ml nitric acid solution. Container was labeled and sealed for transport.

Container No. 4

Silica Gel.

The samples were transported to the laboratory where the following analyses were performed:

Containers Nos. 1 thru 3

Perform analysis by ion chromatography in accordance with Sections 5.3 and 5.4 of Reference Method 29.

Container No. 4

Contents were weighed to nearest 0.5 g and discarded.

4.3 Fuel and Ash Sampling

4.3.1 As Combusted Fuel Sampling Procedures

This procedure was followed for each test day over the course of the sampling program. Two 15-gallon stainless steel containers were labeled A-Fuel and B-Fuel (duplicate) with the date, time of sampling start, time of sampling end and the name of the sampler clearly marked on the container.

Fuel sampling commenced approximately ½ hour before the emissions test starts. All fuel samples were taken from the in-feed conveyor, prior to the fuel entering the metering bin. Using a dedicated ½ gallon stainless steel scoop for each container, the scoop was filled and deposit in container A and the lid closed.

Before placing sample in the container, rocks and metal were removed. At the second 15-minute interval, the as combusted fuel was sampled in the same manner as previously stated using a dedicated scoop for container B. This sampling continued every 15-minutes, alternating between A and B containers, for the entire testing period. This sampling procedure was repeated each day of testing with new scoops and containers required for each new day.

Once the as combusted fuel samples were collected they were delivered, by Boralex, to MEL the day following the emissions testing. All samples had chain-of-custody forms accompanying them.

4.3.2 Flyash Sampling Procedures

The procedure was performed as follows for each test day over the course of the sampling program. Two 5-gallon stainless steel containers were labeled A-Flyash and B-Flyash (duplicate) with the date, time of sampling start, time of sampling end, and the name of the sampler clearly marked on the container.

Sample collection was started approximately one-hour before the start of the emission testing. Again using a dedicated 1-pint stainless steel scoop for each of the sample containers, the scoop was filled, check for rocks and metal, and then deposit the sample in the A sample container. At the second 15-minute interval using the dedicated B scoop, the sample was collected in the same manner as before. Alternating the samples continued until an hour after the emission sampling has concluded. This sampling procedure was then repeated each day of testing with new scoops and containers for each new day.

Once the flyash samples were collected they were delivered to MEL, by Boralex, the day following the emissions testing. All samples had an accompanying chain-of-custody form.

4.3.3 Bottom Ash Sampling Procedures

The procedure was performed as follows for each test day over the course of the sampling program. A 5-gallon stainless steel container was labeled Bottom Ash with the date, time of sampling start, time of sampling end, and the name of the sampler clearly marked on the container.

Sample collection was started approximately one-hour before the start of the emission testing. Again, using a dedicated 1-pint stainless steel scoop, the scoop was filled, checked for rocks and metal, and then deposited in the sample container. Sampling continued until an hour after the emission sampling had concluded. This sampling procedure was repeated each day of testing with a new scoop and a container provided for each new day.

Once the bottom ash samples were collected they were delivered to MEL, by Boralex, the day following the emissions testing. All samples had an accompanying chain-of-custody form.

5.0 QUALITY ASSURANCE

The project manager was responsible for implementation of the quality assurance program as applied to this project.

5.1 Sampling Quality Assurance:

Implementation of quality assurance procedures for source measurement programs was designed so work was done:

- ◆ By competent, trained individuals experienced in the methodologies being used.
- ◆ Using properly calibrated equipment.
- ◆ Using approved procedures for sample handling and documentation.

Measurement devices, pitot tubes, dry gas meters, thermocouples and portable gas analyzers were uniquely identified and calibrated with documented procedures and acceptance criteria before and after the field effort. Records of all calibration data are maintained in the files and presented in the Appendix of the final report. Data are recorded on standard forms. Field notebooks were used to record observations and miscellaneous elements affecting data, calculations, or evaluation.

Specific details of Air Tox's QA program for stationary air pollution sources may be found in "Quality Assurance Handbook for Air Pollution Measurement Systems", Volume III (EPA-600/4-7-027b).

5.2 EPA Reference Methods:

Calibration gases utilized for instrumental analysis methods were prepared in accordance with EPA Protocol 1 or certified to be within $\pm 2\%$ of the cylinder "tag" value concentration. Analyzer linearity, bias, calibration drift, and calibration drift corrections were determined in accordance with Reference Method 6C, as outlined in Section 4.2 of this document.